

REMARKS

In the process of converting a biomass into a blending component for petroleum-derived fuel in which lignin is extracted in a reaction medium from the biomass to provide a lignin feed material that is depolymerized and subsequently hydroprocessed to provide a blending component for use in a petroleum or petroleum-derived fuel, applicants are the first to use water as an inexpensive reaction medium along with alkali hydroxide in amounts of from about 2 to about 5 weight % to obtain high base-catalyzed depolymerization (BCD) activity to ether solubles (about 73 to 74.5 weight percent) unlike the use of alkali hydroxides in super critical alcohol reaction medium, such as methanol and ethanol as disclosed in the inventor primary reference of Shabtai '167.

Claims 1, 4, 7-16, 19, 21, 22, 24, 25, 27-32, 39, 41, 42, 44-48 and 50 were rejected as being unpatentable over Shabtai et al in view of either Jelks or Lucas et al.

Applicants respectfully traverse the rejection and request reconsideration for the following reasons.

Shabtai '167 only efficiently converts lignin into a blending component for petroleum-derived fuel by extracting a lignin-containing fraction in a super critical alcohol from biomass using a base-catalyzed depolymerization reaction at 10% or more of the base by weight, prior to hydroprocessing to produce a blending component. As disclosed in Shabtai et al. '167, at col. 7, lines 14-36, a super critical alcohol such methanol or ethanol is indispensable to its process.

On the other hand, the invention process utilizes water as the reaction medium, wherein the alkali hydroxide is dissolved at low concentrations of 2-5 weight percent to obtain about 73 to 74.5% conversion to ether-solubles from depolymerization, to provide a major technoeconomic advantage of markedly increased depolymerizing activity, and wherein essentially no difference in lignin conversion exists between 2 weight percent to 10 weight percent inclusion of alkali hydroxide and water (see page 10, line 6 – 25 of present specification). Accordingly, applicants' process as well as the results therefrom are drastically different from Shabtai et al. '167 in which alkali hydroxide in the supercritical alcohols depolymerizes, but only at high concentrations of alkali hydroxide equal or greater than 10 weight percent.

Although Shabtai et al. '167 uses alkali hydroxides in alcohol-water mixtures (column 7, lines 37-53), no where does Shabtai '167 suggest or teach use of water alone with alkali.

This glaring deficiency of Shabtai et al. '167 is not compensated for by any teachings in Jelks or Lucas et al.

For example, Jelks only disclose a process for delignification of cellulosic biomass comprising:

- (a) providing a defiberized, lignin-containing biomass of cellulosic material;
- (b) reducing the biomass to a fiber slurry of lignin-containing cellulosic material;
- (c) modifying the lignin in the fiber slurry by a step comprising in situ formation of nascent oxygen, not occurring as a result of hydrogen peroxide decomposition, in the fiber slurry; and
- (d) extracting at least a portion of the lignin from the fiber slurry by washing the fiber slurry with an aqueous solution of an alkaline material.

Therefore, Jelks lacks depolymerizing using alkali with water alone, and there is no reference to or mention of suitability of the final product as a blend in petroleum based fuel.

Lucas et al. only disclose a process for producing ethyl alcohol, but makes no reference to use of same as blend in petroleum-based fuels). Lucas et al.'s process is a continuous treatment of plant biomass using state-of-the-art counter-current extractors to extract salts, proteins and hemicellulose (first extractor); obtaining lignin and silica from the residue coming from the first extractor (second extractor); separating the lignin from the silicate using an ultrafiltration unit, in plants containing a high percentage of silica; producing of ethyl alcohol (ethanol) from the cellulose coming from the second extractor; and producing a mixture of lignin and ethyl alcohol (ethanol) as a high energy fuel.

Thus, only a mixture of lignin and ethanol is produced – and no aromatic hydrocarbon comprising C₇-C₁₀ alkylbenzenes useful as a blend to enhance octane rating of petroleum derived fuel.

Accordingly, even if the methods of obtaining and treating lignin from Jelks or Lucas et al. were substituted for the lignin modification process of Shabtai et al. '167, applicants' invention using a dilute solution of a base in water as the reaction medium would not result.

Claims 17, 18 and 20 have been rejected as being unpatentable over the references as applied to claim 1, further in view of Shabtai et al. '272 under 35 USC §103(a).

The references used to reject main claim 1 have been discussed above.

Shabrai '272 only disclose a process for converting lignin into reformulated, partially oxygenated gasoline by:

(a) providing a lignin material;

(b) subjecting the lignin material to a base-catalyzed depolymerization reaction in the presence of a supercritical alcohol, followed by a selective hydrocracking reaction in the presence of a superacid catalyst to produce a high oxygen-content depolymerized lignin product; and

(c) subjecting the depolymerized lignin product to an etherification reaction to produce a reformulated, partially oxygenated/etherified gasoline product.

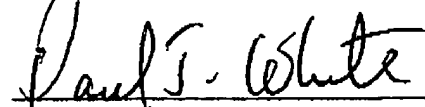
Although Shabtai et al. '272 may use a super based catalyst with methanol, ethanol, or a alcohol-water mixture to affect base-catalyzed depolymerization, no where does Shabrai '272 suggest or teach the use of water per se with base to affect the base-catalyzed depolymerization of lignin. Also, and this is significant, there is no teaching equating the use of a base catalyzed depolymerization using an alcohol-water mixture or alcohol alone to the use of water alone (let alone low concentrations of base in water to effect a depolymerization process.

Thus, even if the depolymerization taught by Shabtai '272 were substituted for or combined with the references used to reject main claim 1, applicants' invention would not result, for the reason that, applicants use a dilute aqueous base solution as an efficient reaction medium for base-catalyzed depolymerization of the lignin using a 2-5 weight percent alkali solution that results in a 73-74.5 weight percent conversion to ether-solubles - whereas the use of alkali in supercritical alcohol reaction medium requires about 10 weight percent or more alkali to affect similar lignin conversion, as indicated in applicants' specification at page 10, lines 6-25.

In view of the foregoing amendments, remarks, and arguments, it is believed that the application is now in condition for allowance and early notification of the same is earnestly solicited.

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Respectfully submitted,



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